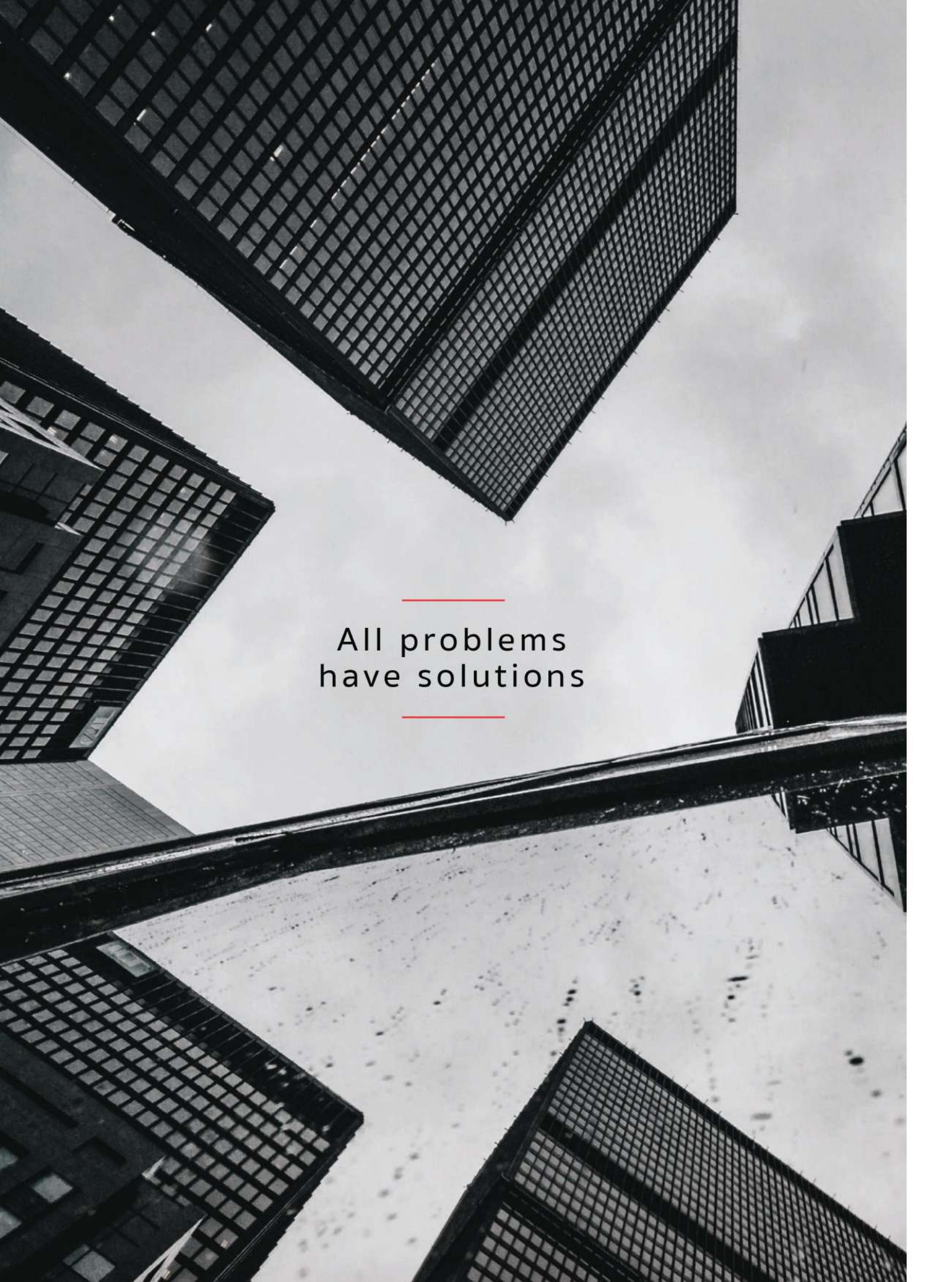
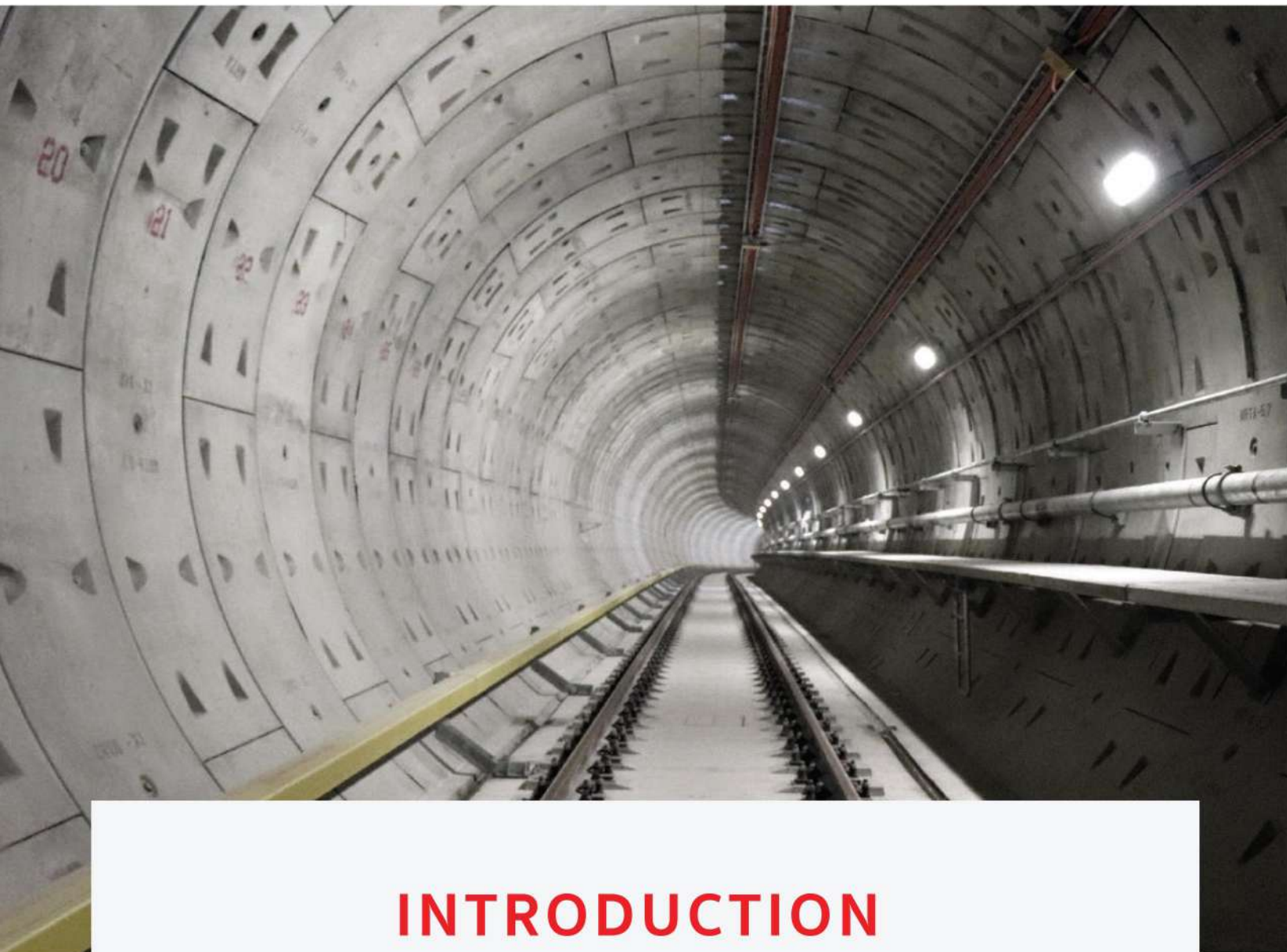


CONCRETE
REPAIR MANUAL

A low-angle, black and white photograph of several modern skyscrapers reaching towards a cloudy sky. The buildings feature a grid-like facade of windows. The perspective creates a sense of height and scale. In the center of the image, the text "All problems have solutions" is displayed in a clean, sans-serif font, flanked by two short horizontal red lines.

All problems
have solutions

CORMIX
One step ahead



INTRODUCTION

Cormix has more than 20 years experience in supplying specialist concrete repair materials. The range of materials available for concrete repair & protection are constantly being enhanced with innovative developments.

Cormix provides fully integrated repair systems formulated for ease of application, fast installation & cost effectiveness.

Cormix Technical service team is available to assist in the assessment of the repair jobs, to identify the cause of damage, evaluate various repair options, select the relevant repair method and assist with method statements and specifications.

Cormix is perfectly positioned to assist designers & facility owners in selection and specification of the most cost effective repair system and to provide ongoing support to the specialist repair contractor before and during work.

The methods and procedures described in this manual are in accordance with recommendations from ACI, ICRI (USA) and European Standard (EN).

Products contained herein are for Repair & Protection of Reinforced Concrete and are in accordance with European Standards EN1504.

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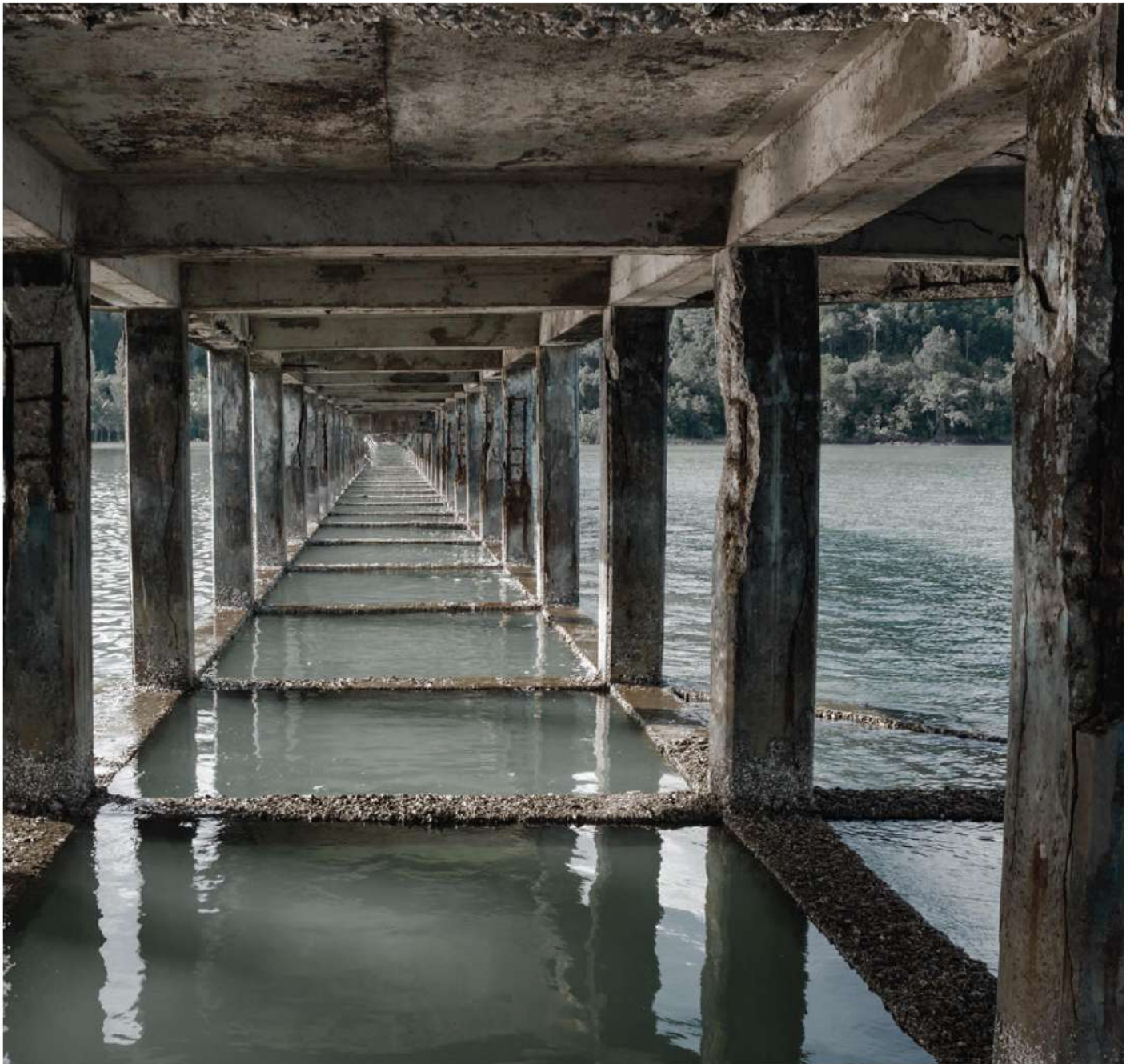
CAUSES OF CONCRETE DETERIORATION

Concrete is often exposed to multiple processes of deterioration contributing to damage & finally failure. It maybe exposed to various salts, carbonation (acid rain) as well as bio deterioration.

Concrete has a highly alkaline environment and passivates embedded reinforcement protecting steel from corrosion. This passive environment may be broken down by decreasing the PH of the concrete or attack from aggressive elements e.g. chlorides.

Whilst the passive environment exists steel is immune to corrosion, however, when the concrete becomes carbonated the PH may fall causing the passivity to be lost.





Chlorides may also induce corrosion despite a high PH, once chlorides reach the steel corrosion occurs. Salts such as sulphates can attack and damage concrete through a reaction with the hydration of cement by products to form sulphate containing phases such as ettringite and gypsum which expand, crack and soften the cement paste.

Heavy marine growth in tidal located structures may also cause bio deterioration.

In summary concrete may be corroded by a number of everyday contaminants:

- Carbon dioxide in the atmosphere
- Airborne Chlorides
- Salt water
- Salts contained in ground water

Once corrosion of reinforcement progresses its volume changes causing cracking & eventual spalling of the concrete's surface. In addition contaminants at work in the cement paste may cause softening expansion cracking, and spalling of the cement matrix.

Deterioration of reinforced concrete structures can be broadly categorized as follows:

- Corrosion of reinforcement steel as a result of carbonation or chloride attack.
- Chemical attack of cement paste for example sulphate or other water borne dilute acids.
- Impact, abrasion or physical damage from traffic.
- Overload,
- Movement, settlement,
- Freeze thaw etc.
- Poor construction methods resulting in cracking, honeycombs, low cover to rebar or porous concrete



To achieve an effective repair the cause of deterioration of the concrete must be established if not the repair may well fail prematurely.

Repair product technology has advanced significantly over the last few years and is shown later in this manual

Repair options are covered in EN 1504 the principles are highlighted in this manual with those Cormix products complying to the standard listed.

Repairs can be divided broadly to concrete removal and reinstatement and nondestructive methods which control or inhibit ongoing or future electrochemical reactions on the reinforcement. This manual focuses on removal and reinstatement.

Removal and reinstatement of concrete will provide long term solutions providing undertaken systematically following good practice:

- Sound investigations determining causes and extent of deterioration
- Correct selection of repair materials and installation strategy
- Right breakout methods and surface preparation
- Steel reinforcement adequately cleaned and replaced as required
- Priming of the reinforcement.
- Using the correct bonding bridge
- Applying the repair mortar correctly either mechanically or by hand
- Curing of the repair medium and installation of carbonation coating



Such repairs may be done in conjunction with nondestructive methods such as migrating corrosion inhibitors

Repair materials may be applied in different ways as displayed in this manual, by hand, poured, pumped or sprayed these are covered in EN 1504

Mortars are classified into non structural R1 and R2 and structural R3 and 4 for structural repairs Cormix products complying to the relevant class are shown in the section referring to EN 1504

Many factors must be considered when selecting materials and should take into account the required performance criteria and relevant national and international standards such as EN 1504

Selection of the repair materials is influenced by factors such as:

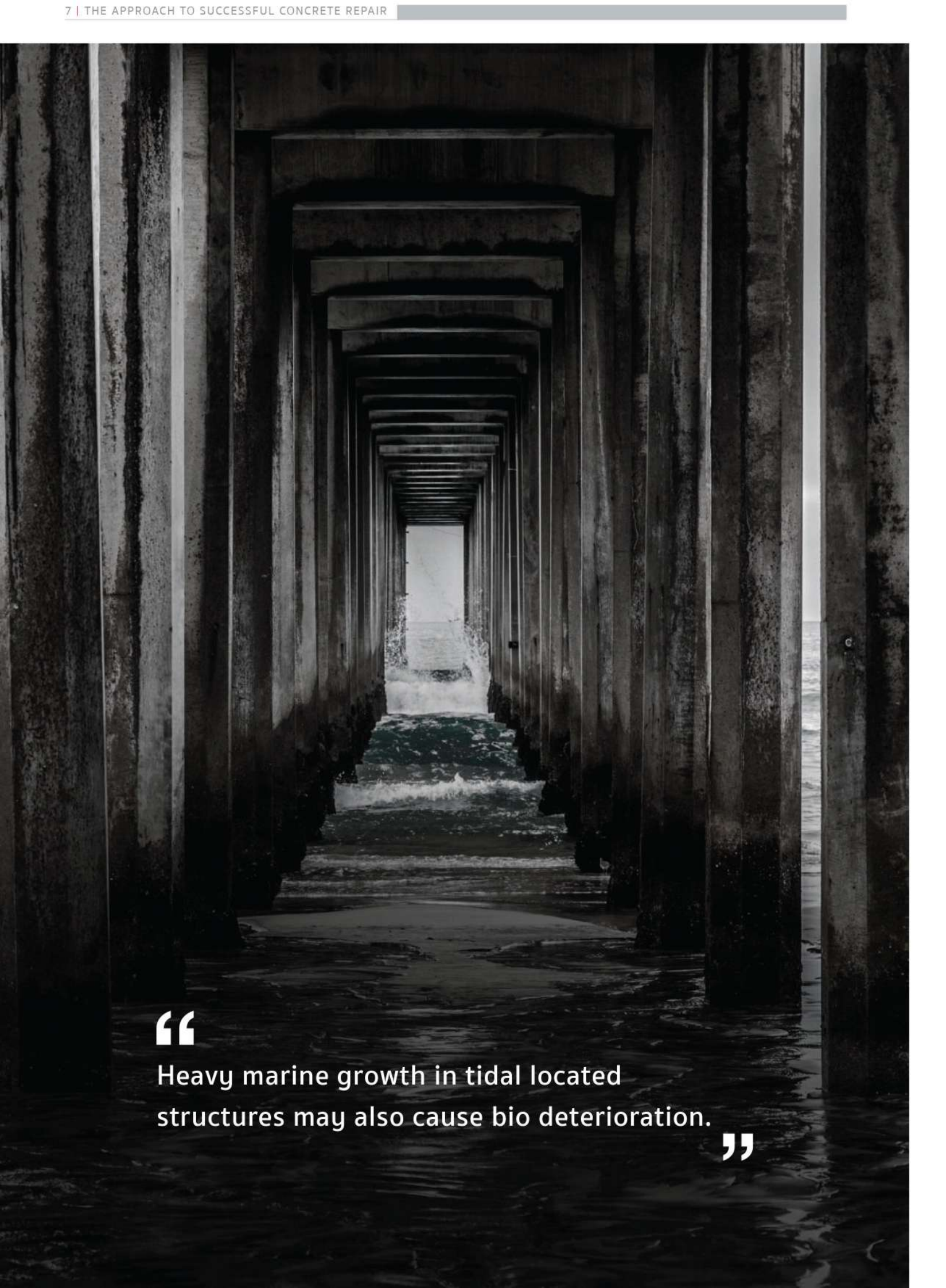
- Access
- Size of the repair
- Return to service requirements
- Service conditions eg. presence of chlorides, carbon dioxide, water, vibration etc
- Subsequent finishes such as coatings
- Structural or non-structural repair



The selected material should have the required compressive strength, good bond strength, be shrinkage compensated, have good dimensional stability both thermal expansion and drying shrinkage, exhibit water permeability and absorption equal to or better than high performance concrete.

The following pages provide some insight into concrete deterioration, the basics of substrate preparation, a summary of application methods, concrete repair solutions available from Cormix a selection chart, EN standards, crack repair, injection, and curtain grouting.

Cormix Technical service is available to provide advice and assistance with specifications, method statements and onsite demonstrations.



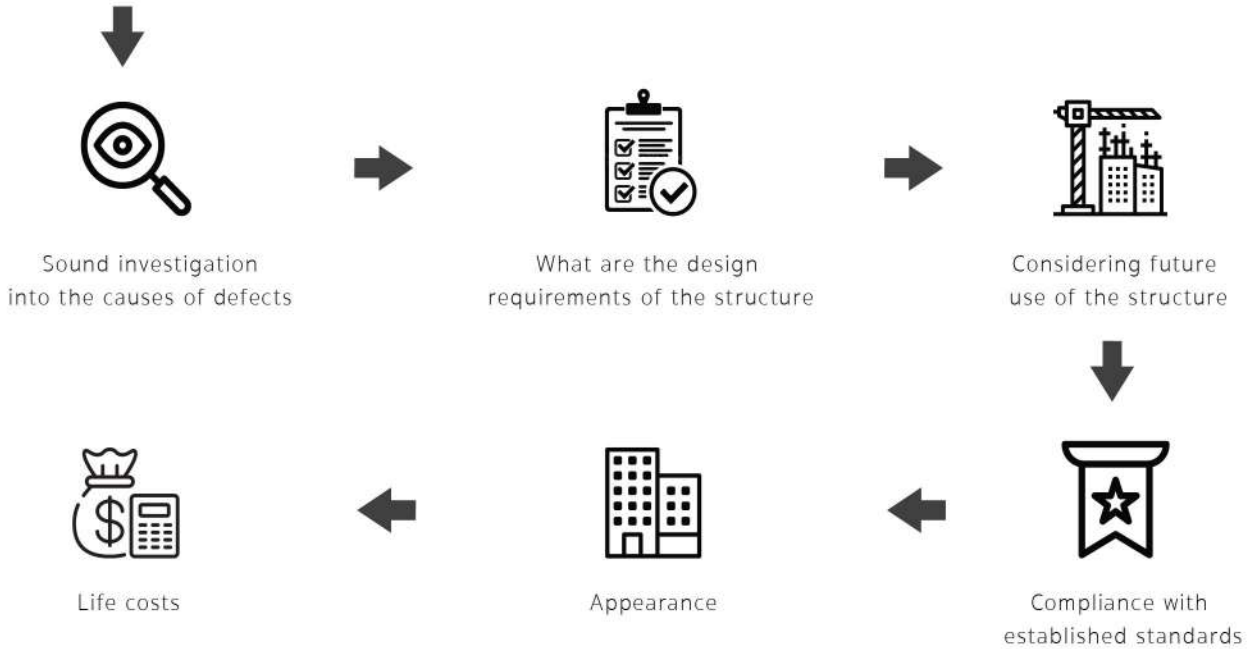
“

Heavy marine growth in tidal located structures may also cause bio deterioration.

”

REPAIRING OF REINFORCED CONCRETE

To achieve a successful concrete repair the approach should include:



A systematic approach is required to achieve a successful concrete repair.

The main factors responsible for concrete repair failures

Incorrect application and curing

Wrong specification /selection

Treating the result not the causes of deterioration

Poor surface preparation

Misunderstanding the causes of deterioration



BASICS OF SUBSTRATE PREPARATION

Correct substrate preparation is essential to achieve a sound repair.

Mark out the damaged area extending the area to be removed at least 15 cm beyond delaminated concrete. Keep the repair areas configuration simple this may result in the removal of some sound concrete.

Undercut exposed reinforcement to the full circumference. Chloride contaminated concrete should be removed. If all concrete cannot be removed to expose rebar consider corrosion inhibiting systems such as a migrating corrosion inhibitor Cormix NCI

To assess conditions beyond the repair area chloride contents and pH levels should be checked at the level of the rebar, if chloride contents are deemed too high or the concrete carbonated a corrosion inhibitor may be used to prevent future corrosion.

Concrete removal should extend along the rebar until no further cracking or delamination is apparent and the steel is sound and well bonded to the concrete. In very bad cases complete concrete removal may be required. The perimeter of the repair should be saw cut to provide a vertical edge with no feather edging the depth of the removed concrete should be uniform and undercut the exposed rebar

High impact mechanical removal of concrete can result in fractured weakened concrete below the repair, high water pressure blasting or abrasive blasting will remove damaged material and any dirt grease or other bond inhibiting material. Rebar should have all concrete and corrosion deposits removed by blasting with oil free abrasives or water.

If reinforcement has lost cross sectional area a structural engineer should be consulted, supplemental reinforcement maybe required and should extended beyond the damaged area.

Immediately before placing the repair material the area should be finally inspected for any bond inhibiting materials such as dirt, dust, loose aggregates.

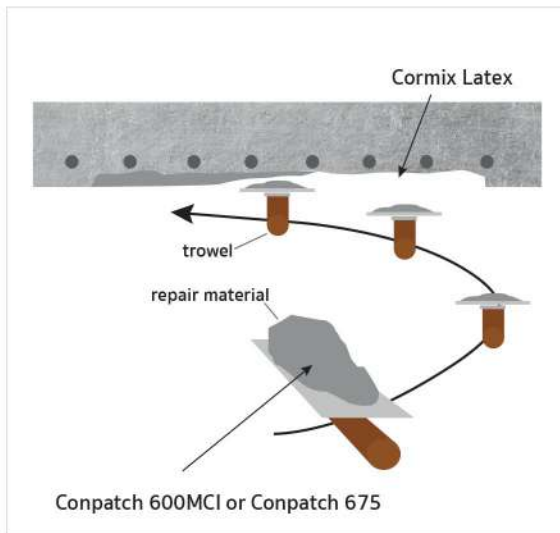
A tensile pull off test may be established in the performance specification for the job



SUMMARY OF SOME APPLICATION METHODS

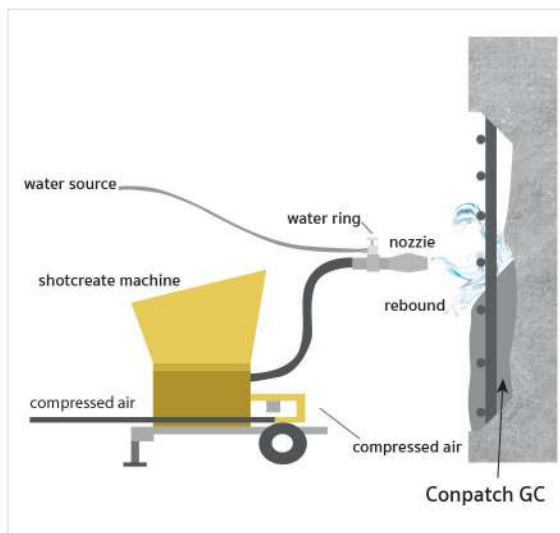
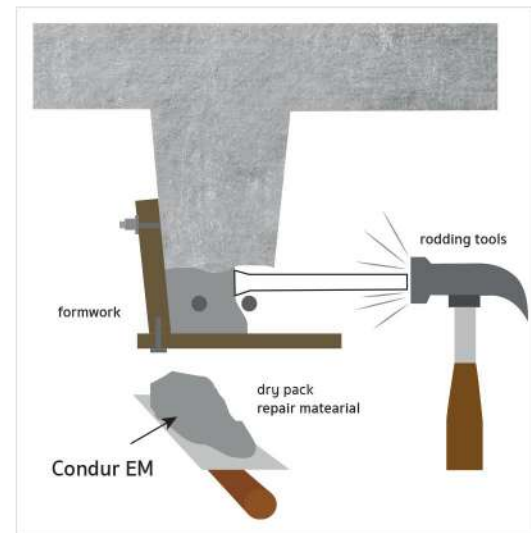
Trowel applied

General description : Repair material is mixed into a trowelable, non-sag consistency. Trowels or other suitable placing tools are used to apply the repair material to the prepared substrate. The repair material is pressed into the substrate to develop intimate contact without voids.



Dry Packing

General description: Repair material is mixed into a uniform, cohesive plastic state, then transported to a confined space and compacted with rodding tools to produce a dense repair material.



Dry-mix shotcrete

General description: Repair material is placed dry or slightly damp into shotcrete machine and mixed with compressed air. The mixture is transported via hose to the exit nozzle where water and admixtures, if any, are introduced. The ingredients are propelled onto the prepared substrate by the force of the compressed air.

Best application: Large vertical and overhead areas with small bars, 19 mm or less, and minimal congestion of embedded reinforcement.

Material requirements: Well graded aggregate with necessary binders (usually Portland cement). Mixture must be proportioned to compensate for rebound losses. Admixtures are frequently used to shorten set time, and or to allow thicker layers to be built-up in a single pass.

Reference: ACI 506.2, "Guide to Shotcrete"

- Conpatch GC – Dry mix shotcrete
- Elastoclad – Anti Carbonation Coating

Wet-mix shotcrete

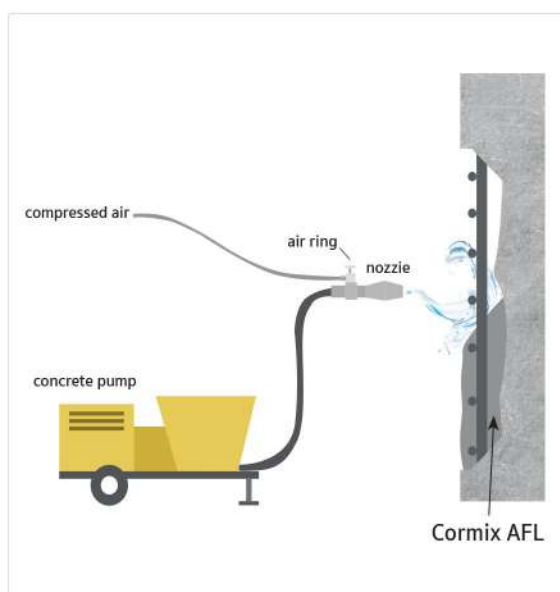
General description: Pre-batched and thoroughly mixed repair material is placed into a concrete pump and transported via pump line to an exit nozzle where compressed air and admixtures, if any, are introduced. The repair material is propelled onto the surface by the compressed air.

Best application: Large vertical and areas with small bars, 19 mm or less, and minimal congestion of embedded reinforcement.

Material requirements: Pumpable, low-slump mixture which does not sag when impacted on the prepared substrate.

Reference: ACI 506.2,
“Guide to Shotcrete”

- Cormix AFL – Shotcrete accelerator
- Elastoclad – Anti Carbonation Coating



Form and pump

General description: Repair material is mixed and pumped via concrete line connected to the formwork, until the cavity is filled and pressurized.

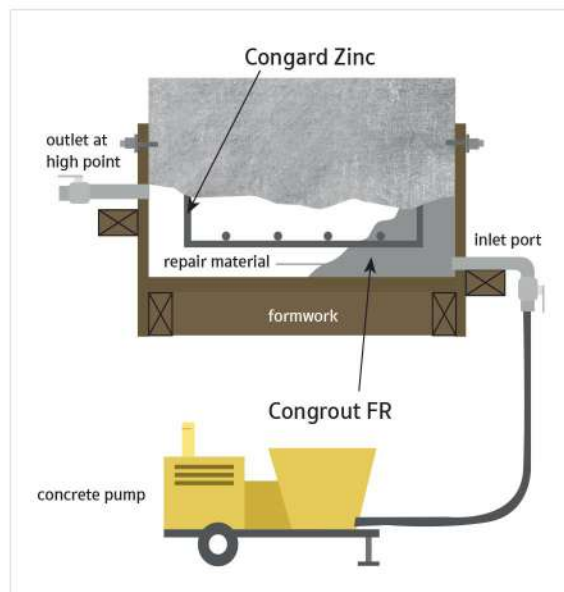
Consolidation and bonding is provided by the internal form pressure.

Best application: Overhead and vertical applications where congested reinforcing is present. Beam bottoms, ribs, slab soffits, or sectionalized areas.

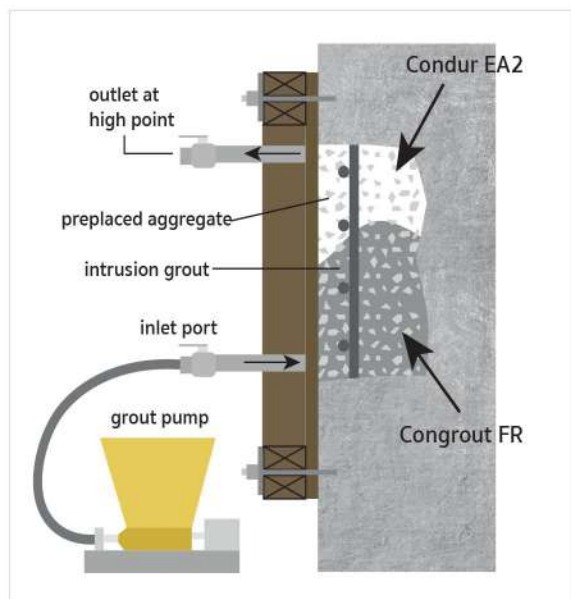
Material requirements: Pumpable, good flow characteristics, self-bonding, aggregate size compatible with size of cavity and space between bars.

Reference: ACI 304.2R,
“Placing Concrete by Pumping Methods.”

- Congrout FR – Non Shrink fibre reinforced cementitious grout
- Conpatch MC – Micro concrete
- Elastoclad – Anti Carbonation Coating



Preplaced aggregate



General description: Gap-graded aggregate is placed into formed cavity. Grout is then pumped into form via grout pump until all voids are filled and pressurized. Shrinkage is minimal because of aggregate contact and volume.

Best application: Vertical and overhead applications where extremely low shrinkage of repair material is required; column enlargements.

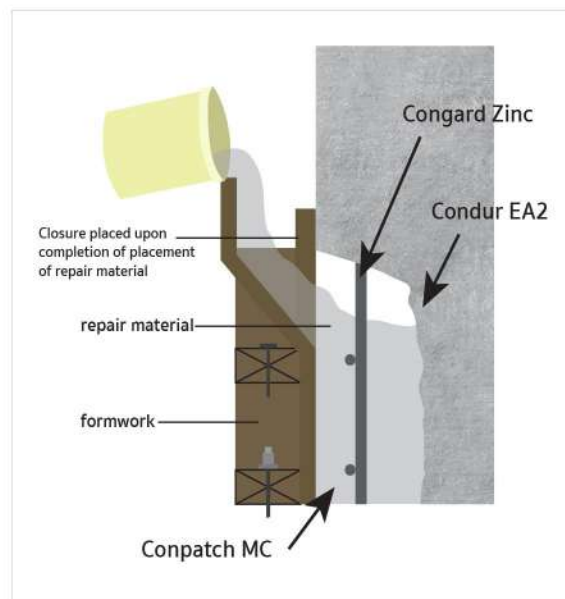
Material requirements: Gap-graded aggregate (40-50% void ratio), pumpable grout, self-bonding port-land cement or resin-based binder. One inch (25 mm) or larger aggregate typically used in cementitious applications.

Reference: ACI 304.1R,

“Guide for the Use of Pre-placed Aggregate Concrete for Structural and Mass Concrete Applications.”

- Congrout FR – Non Shrink fire resistant cementitious grout
- Elastoclad – Anti Carbonation Coating

Form and cast-in-place



General description: The placement of repair material into a confined space with formwork defining all exposed boundaries.

Repair materials are deposited into the formwork and consolidated by rodding or conventional vibration.

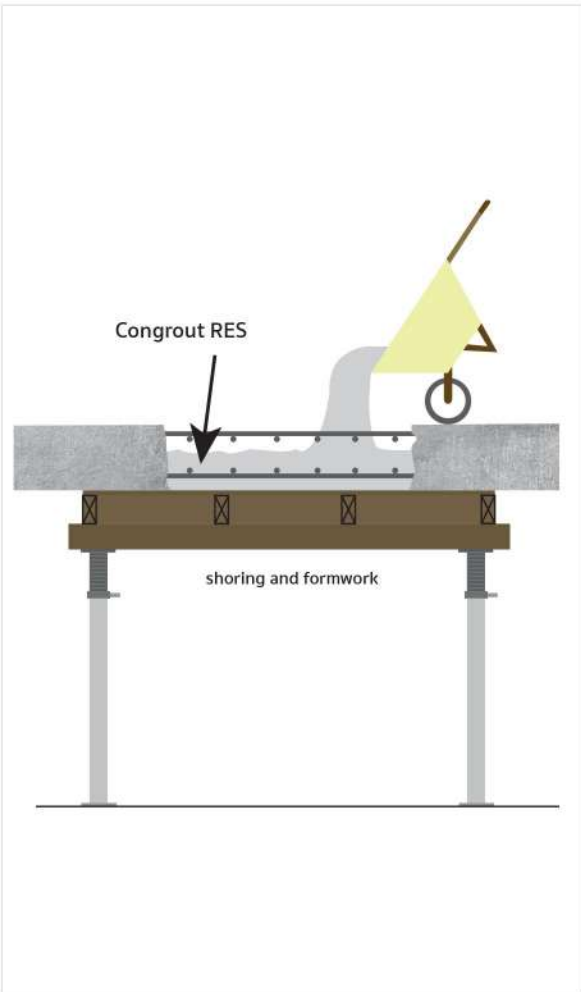
Best application: Columns, walls, and exterior slab edges.

Material requirements: Castable concrete or mortar with proper bond properties, low shrinkage, low water/ cement ratio, and a highly flowable mixture.

Reference: ACI 304R,

“Guide for Measuring, Mixing, Transporting, and Placing Concrete.”

- Conpatch MC – Micro concrete
- Condur EA2 – Epoxy adhesive
- Elastoclad – Anti Carbonation Coating



Form and cast-in-place

General description: In lieu of partial-depth repairs, the member in question can be removed and replaced in total. Placement methods should follow good concrete practice.

Best application: When deterioration is extensive throughout the member.

Material requirements: Conventional cast-in-place concrete with low shrinkage, low water-cement ratio, and a highly workable mixture.

Reference: ACI 304R,

“Guide for Measuring, Mixing,
Transporting, and Placing Concrete.”

- Congrout RES – Rapid early strength repair mortar or
- Conpatch MC – Micro concrete

A large commercial airplane is parked on a runway. The foreground shows significant concrete cracking on the tarmac. Another airplane is visible in the background, flying in the sky. The scene is set during sunset or sunrise, with a warm glow on the horizon.

INNOVATIVE CONCRETE REPAIR SOLUTIONS FROM CORMIX

HIGH PERFORMANCE CONCRETE REPAIR MORTARS

Fairing & Light Weight Repair Mortars



Conpatch 300

EN 1504-3 class R3

Polymer Modified Fairing Mortar
for thin layer applications



Conpatch 635

EN 1504-3 class R3

Polymer modified medium weight
repair mortar for vertical & overhead repairs

Conpatch 675

EN 1504-3 class R3

High performance light weight over head
& vertical repair mortar with high build properties

Structural Repair Mortars

The below repair mortars have been tested to EN 1504 & are suitable for structural repairs to this standard

Conpatch 600MCI

EN 1504-3 class R4

High performance fibre reinforced repair mortar containing a migrating corrosion inhibitor

- Contains MCI
- Low shrinkage
- Low permeability
- High adhesion

Conpatch 600HS

EN 1504-3 class R4

Very high strength repair mortar

- Very high strength
- Low shrinkage
- Very low permeability
- High adhesion



Conpatch MC

EN 1504-3 class R4

A flowing micro concrete

- Use for repair of large sections
- Pump or pour
- Self compacting
- Excellent chloride & carbonation resistance

Conpatch GC

EN 1504-3 class R4

Spray applied high build & strength repair mortar

- Low rebound
- Ideal for big repair areas such as jetties, tunnels, waste, water systems
- High build & strength



STRUCTURAL STRENGTHENING WITH CARBON FIBRE

Condur CF Series

EN 1504-4

- Plates & Fabric
- Bonded with Condur CF Adhesive & Impregnation

REPAIR MORTARS FOR SPECIALIZED APPLICATIONS

Congrout UWG

EN 1504-3 class R4 Under Water Grout

- No wash out
- Very dense
- No segregation
- Low shrinkage
- Low permeability

Conpatch Marine

EN 1504-3 class R4

Fast setting repair mortar for tidal zones

- No wash out
- Very dense
- No segregation
- Low shrinkage
- Low permeability



Congrout RES

EN 1504-3 class R4

Very fast setting repair mortar

- Very early strength
- Trafficable in < 3 hours
- Low shrinkage
- Good abrasion resistance
- Good adhesion

Condur ARP

EN 1504-3 class R1 (Non Structural Mortar)

Elastomeric Concrete for urgent repairs such as taxiways and roads joints.

- Trafficable in < 2 hours
- Excellent adhesion
- Flexible
- Vibration resistant
- Abrasion resistant

EPOXY REPAIR ADHESIVES, MORTARS & CRACK INJECTION



Condur EA1

EN 1504-7, EN 1504-3 class R4

Epoxy Adhesive

Condur EA2

EN 1504-4

Epoxy Adhesive for wet concrete to dry

Condur SC

EN 1504-5 Type F: Transmitting force

Low viscosity injection resin, non shrink,
high strength

Condur EM

EN 1504-9 principle 6

Method 6.3

Heavy duty epoxy repair mortar for large voids

Condur 41

EN 1504-3 class R4

Re profiling mortar for precast units, damaged
arises, minor repairs

Condur FEA

EN 1504-9

Epoxy flexible mortar & adhesive/sealant

Condur Anchor

EN 1504-3 class R4

Epoxy Anchoring

Condur FC

EN 1504-3 class R4

Epoxy Fairing mortar

POLYURETHANE CRACK INJECTION SEALANTS



Contite PUE 200/E201

EN 1504-5 Type D: Flexible resin
supporting successive movement

2 part environmentally friendly
flexible crack injection resin

Contite PUE 300/301

EN 1504-5 Type F: Transmitting force

2 part environmentally friendly rigid
structural repair injection resin



Contite PUE 400/E401

EN 1504-5 Type D: Flexible resin
supporting successive movement

EN 1504-5 Type S: Expansive
filling of cracks

2 in one environmentally friendly
crack injection resin. Foams first
then seals permanently

POLYURETHANE FOAMS & GELS FOR SLAB LIFTING & NEGATIVE SIDE WATERPROOFING



Contite PUE 500/501

EN 1504-5 Type S: Expansive filling of cracks and voids.

1:1 rigid polyurethane foam, high early strength use for slab lifting & preventing underground water movement

Contite G600

EN 1504-5 Type F: Expansive filling of cracks and voids.

1:1 – 1:5 Hydrophilic polyurethane Gel for negative side water proofing & heavy water shut off



PROTECTIVE COATING & IMPREGNATIONS

The correct selection of Cormix repair mortars will ensure long lasting repairs, however, the rest of the structure is potentially exposed to future attack

Correctly selected coating systems can prevent the concrete from future damage from salts or gases entering the cement matrix & reaching the reinforcement

Coating or impregnations should allow the structure to breathe and consideration should be given to the conditions e.g. high humidity, rainfall, UV & temperature differentials

PROPERTIES REQUIRED FOR A SUITABLE PROTECTIVE COATING



Before



After

Excellent weathering, UV & ponding resistance
Aesthetically pleasing
Allow moisture movement
Prevent the ingress of carbon dioxide & chlorides

The following protection systems are available
from Cormix

Silane Impregnation

Deep penetrations & excellent resistance to high alkalinity, colourless they form a stable bond with the concrete pores & capillaries. The silane molecule stands proud from the pores giving high hydrophobic performance



Contite 40

EN 1504-2

- Excellent Penetration
- Optimum resistance to alkalis
- Reduce dramatically chloride & water absorption
- Retains breathability
- Good resistance against freeze thaw

Contite Watershield

EN 1504-2

- Water based Reduces water & chloride penetration
- Breathes Minimize efflorescence
- Non staining

CORMIX COATING SYSTEMS



Waterproof Coating

Elastodeck S

EN 1504-2

- High performance low build acrylic protective coating.
- Highly UV resistance
- Durable in all climates
- Barrier against gases, salts, oxygen, water etc.
- Water based

Elastoclad

EN 1504-2

- High performance crack accommodating acrylic & decorative coating
- Good movement capacity
- Excellent barrier against salts, gases, water, oxygen etc.
- Very high UV resistance
- Water based

Elastoclad PU(N)

EN 1504-2

- High performance hybrid polyurethane waterproofing system
- Highly UV resistant
- Durable in all climates
- Excellent crack bridging
- Barrier against gases, salts, oxygen, water etc.
- Water based

Protective Coating

Congard ST

EN 1504-7

- High build, high solids epoxy coating for rebar.
- Aluminium pigmented version
- Corrosive barrier protection to rebar and steel.

Congard Zinc

EN 1504-7

- Epoxy Zinc Primer
- Anti Corrosive Coating rebar and steel.

Conpatch NCI

EN 1504-7

- Surface applied migrating corrosion inhibitor for concrete rebar protection.
- Extend service life of the structure for below and above ground structures.
- Water based
- Non flammable



The wide innovative product range available from Cormix allows it to differentiate itself from many of its competitors, this coupled with its dedication to the pursuit of excellence, R&D and excellent quality positions Cormix well in the field of construction chemicals

SELECTION CHART

Crack Injection Polyurethane & Epoxy

Application/Description	Products
Dry Crack	Condur SC
	Contite PUE 300/301
Wet/Damp Crack	Contite PUE 200/201
	Contite PUE 300/301
	Contite PUE 400/401
Running Water Crack	Contite PUE100/E101
	Contite PU100 (1K)
	Contite G600
Moving Crack	Contite PUE 200/E201
Static Crack	Condur SC
	Contite PUE 300/301

EN 1504-5 Type F: Transmitting force
EN 1504-5 Type D: Flexible resin supporting successive movement
EN 1504-5 Type S: Expansive filling of cracks and voids.





Rebar Protection

Application/Description	Products	
Limited Cleaning Possible	Congard ST	EN 1504-7
Good Clean up Possible	Congard Zinc	EN 1504-7
Concrete left in place	Conpatch NCI	EN 1504-7



Bonding Bridge

Application/Description	Products	
Epoxy Adhesive	Condur EA2	EN 1504-4
Latex Adhesive	Cormix Latex	

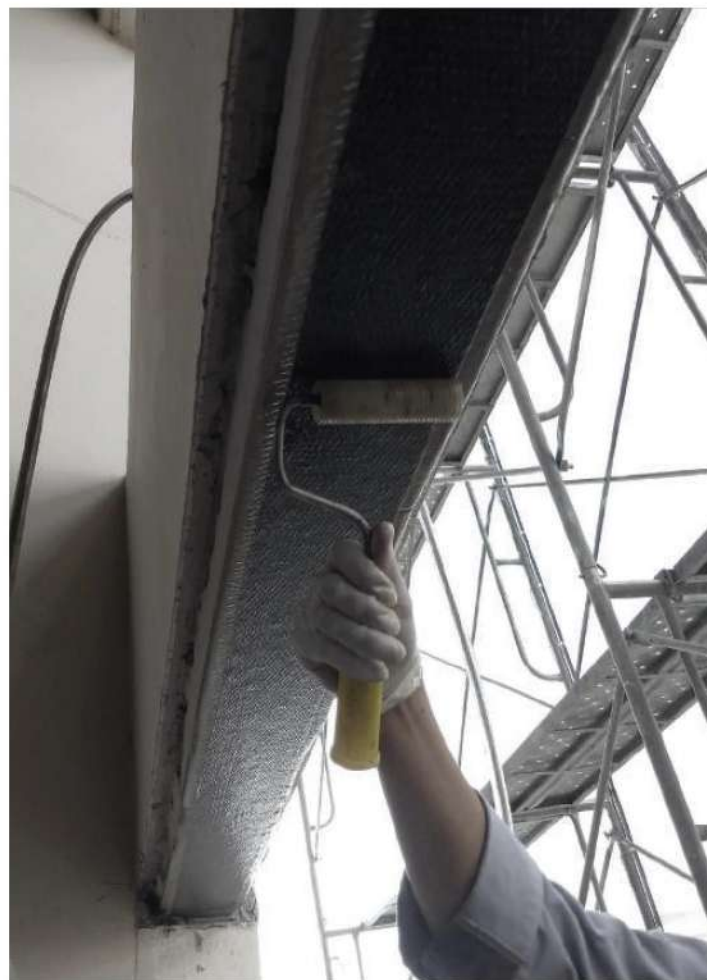


Reprofiling Cementitious Mortar
Non structural mortars

Application/Description	Products	
Cosmetic Surface Blemishes	Conpatch 300	EN 1504-3 class R3
Vertical & Overhead	Conpatch 635	EN 1504-3 class R3
Vertical & Overhead high build	Conpatch 675	EN 1504-3 class R3

Structural Mortars

Application/Description	Products
Hand & or spray application	Conpatch 600MCI EN 1504-3 class R4 Conpatch 600HS EN 1504-3 class R4
Pouring/Forming	Conpatch MC EN 1504-3 class R4 Congrout FR EN 1504-3 class R4
Pumping	Conpatch MC EN 1504-3 class R4 Congrout FR EN 1504-3 class R4
Shotcrete	Conpatch GC EN 1504-3 class R4



Structural Strengthening

Application/Description	Products
Carbon Fibre structural strengthening	Condur CF Series EN 1504-4

Specialist Repair Mortars (Cementitious & Epoxy)

Application/Description	Products	
Fast setting and High early Strength	Congrout RES	EN 1504-3 class R4
Fast setting for tidal zone	Conpatch Marine	EN 1504-3 class R4
Fast setting for road/joint repairs with flexibility	Condur ARP	EN 1504-3 class R4
Under water Repair	Congrout UWG	EN 1504-3 class R4
	Condur UEG	EN 1504-3 class R4



Reprofiling Epoxy Mortars

Application/Description	Products	
Epoxy Fairing Mortar	Condur FC	EN 1504-3 class R4
Arises Repair	Condur EA1	EN 1504-7, 1504-3 class R4
Patching & deep repairs	Condur 41	EN 1504-3 class R4
	Condur EM	EN 1504-9 principle 6, Method 6.3
Flexible epoxy mortar & joint filler	Condur FEA	EN 1504-9
Rebar & Anchor Fixing	Condur Anchor	EN 1504-3 class R4



Protective Coating, Impregnations & Water Repellants

Application/Description	Products	
Hydrophobic Water Repellants	Contite Watershield	EN 1504-2
	Contite 40	EN 1504-2
Hydrophobic Water Repellants Combined with Crystalline waterproofing	Contite HHH	EN 1504-2
Elastomeric Carbonation Coating	Elastodeck S	EN 1504-2
	Elastoclad	EN 1504-2

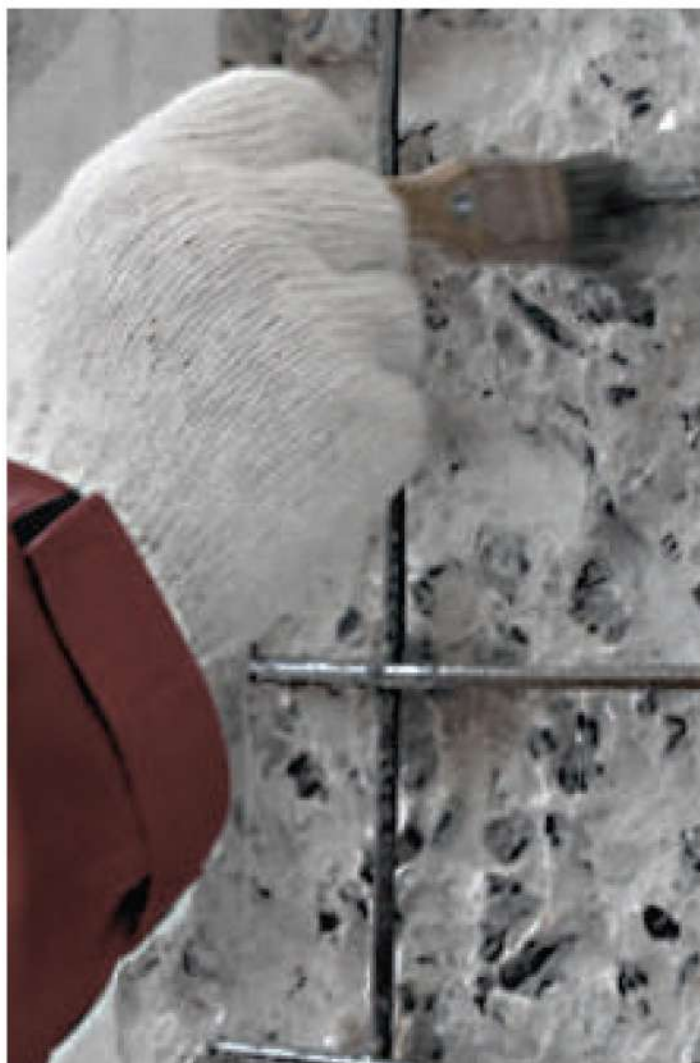
PHOTOTELLING SURFACE DEFECT REPAIR



REBAR PROTECTION & MIGRATING CORROSION INHIBITOR

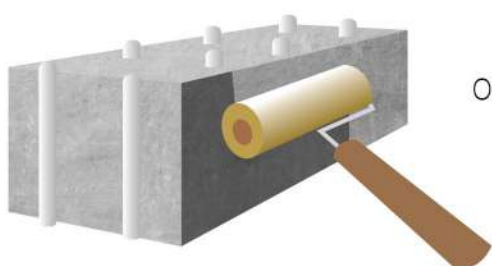
Congard ST

EN 1504-7



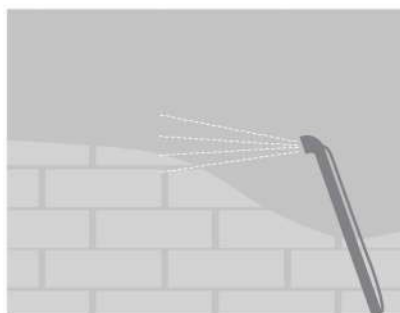
Congard Zinc

EN 1504-7

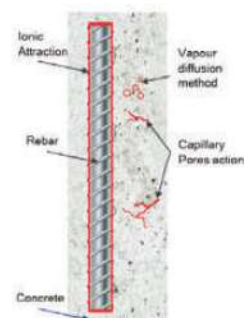


Roller

Or



Low pressure spray equipment



Conpatch NCI

EN 1504-7

BONDING BRIDGES

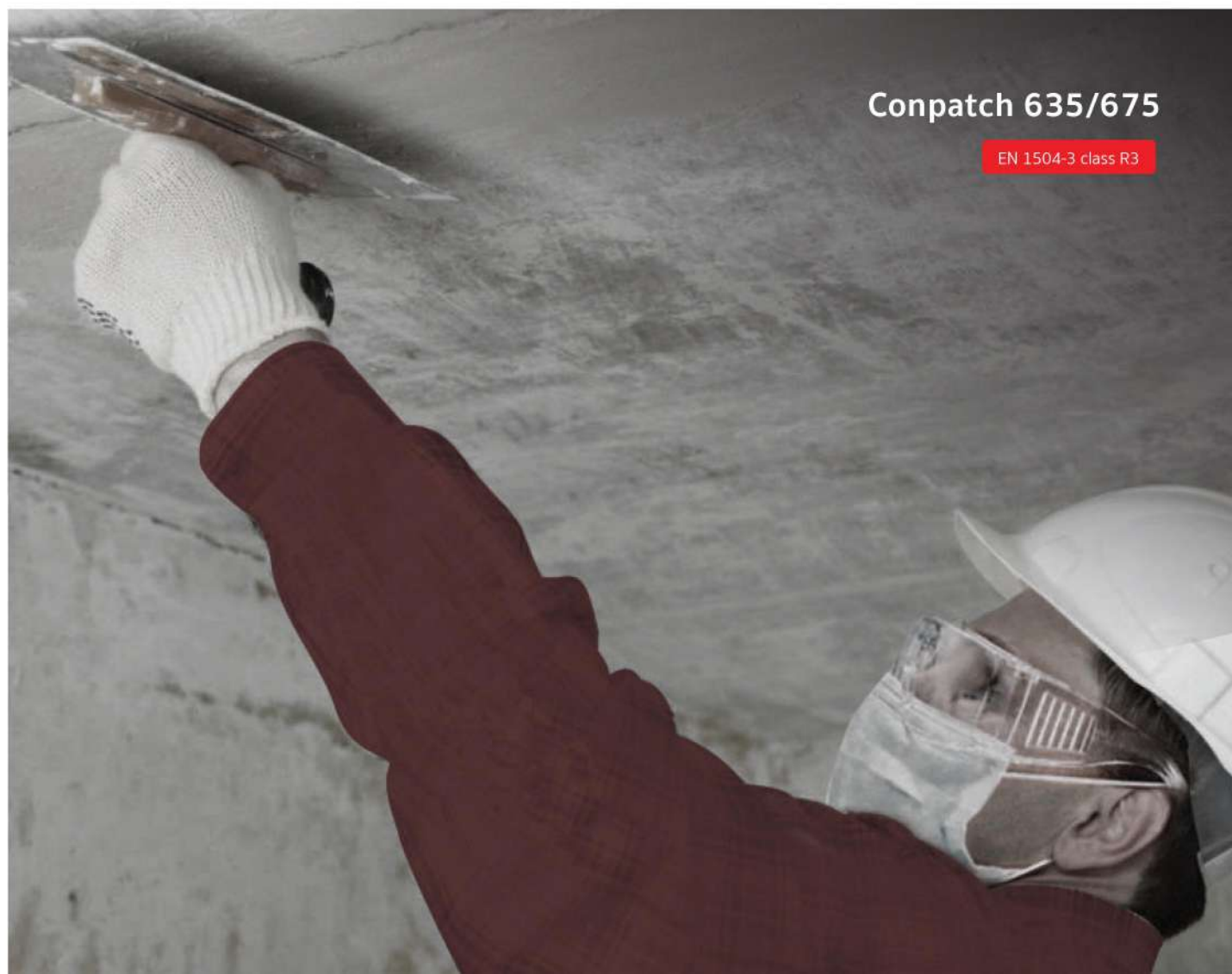
Condur EA2

EN 1504-3, 4



Cormix Latex

REPROFILING BY HAND (CONPATCH REPAIR MORTAR)



REPROFILING BY SHOTCRETE

Conpatch GC

EN 1504-3 class R4



REPROFILING BY POURING



Conpatch MC

EN 1504-3 class R4

REPROFILING BY GROUTING

Congrout 1000

EN 1504-3



REPROFILING BY UNDERWATER GROUTING

Congrout UWG

EN 1504-3 class R4



CRACK INJECTION

Condur SC

EN 1504-5 Type F



PROTECTION

Contite HHH

Contite 40

Contite Watershield

EN 1504-2



PROTECTION ELASTOMERIC COATING

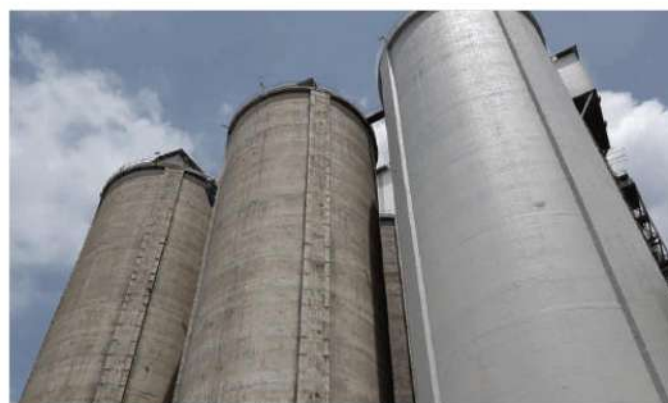
Elastoclad, Elastoclad PU(N), Elastoclad PU, Elastoclad HR

EN 1504-2



Elastodeck S

EN 1504-2



“
**CONCRETE REPAIR,
PROTECTION AND
INJECTION
WITH CORMIX**

Products Conforming with
European Standards EN1504

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PRINCIPLE	METHOD	EN 1504 PART	PRODUCTS
EN 1504 PART 9 - PRINCIPLES & METHODS RELATED TO DEFECTS IN CONCRETE			
1 Protection against ingress (PI)	1.1 Hydrophobic impregnation	2	Contite 40 Contite Watershield Contite HHH
	1.2 Impregnation	2	Contite Contite HHH Contop S
	1.3 Surface coating	2	Elastoclad Elastoclad PU Elastoclad PU(N) Elastodeck S Congard Acrylic
	1.4 Surface binding of cracks		Conflex Band
	1.5 Filling cracks	5	CLASS (F) Contite PUE 300/301 Condur SC CLASS (D) Contite PUE 200/201 Contite PUE400/401 CLASS (S) Contite PUE100/101 Contie PU100/101 Contite PU100(1K)
	1.6 Transforming cracks into joints		Conflex PS Conflex Band
	1.7 Erecting external panels		
	1.8 Application of membranes		Elastoclad Elastoclad PU Elastoclad PU(N) Contite FCW Contite HPWM Contite CFM

PRINCIPLE	METHOD	EN 1504 PART	PRODUCTS
2 Moisture control (MC)	2.1 Hydrophobic impregnation		Contite 40 Contite Watershield Contite HHH
	2.2 Impregnation	2	Contite Contite HHH Corcure 75 Contop S
	2.3 Surface coating	2	Elastoclad Elastoclad PU Elastoclad PU(N) Elastodeck S Congard Acrylic
	2.4 Erecting external panels		
	2.5 Electrochemical treatment		
3 Concrete restoration (CR)	3.1 Applying mortar by hand	3	Conpatch 600 MCI Conpatch 600 Conpatch 600 TP Conpatch 600 HS Conpatch 635 Conpatch 675 Conpatch 300 Condur EA1 Condur EF Condur 41
	3.2 Recasting with concrete or mortar	3	Condur EM Condur EGLP2 Condur EG Condur EGHS Condur UEG Congrout UWG Congrout GP Congrout FR Congrout 1000 Congrout 4000 Congrout RES Conpatch MC

PRINCIPLE	METHOD	EN 1504 PART	PRODUCTS
4 Structural strengthening (SS)	3.3 Spraying concrete or mortar	3	Conpatch GC Conpatch 635 Conpatch 675 Conpatch 600 MCI Conpatch 600 Conpatch 600 TP Conpatch 600 HS Conpatch Marine
	3.4 Replacing elements	3	Condur EA2 Condur EA2 (HP)
	4.1 Adding or replacing embedded or external reinforcing steel bars		Condur CF Adhesive Condur EA1
	4.2 Installing bonded rebars in preformed or drilled holes in the concrete	6	Condur Anchor Condur EA1 Condur EGHES
	4.3 Plate bonding	4	Condur CF Fabric Condur CF Plate Condur CF(HP) Impregnation Condur CF Adhesive
	4.4 Adding mortar or concrete	3, 4	Conpatch 600 MCI Conpatch 600 Conpatch 600 TP Conpatch 600 HS Condur EA1 Condur EF Condur EA2 Condur EA2(HP) Condur 41
	4.5 Injecting in cracks, voids or interstices	4	CLASS (F) Contite PUE 300/301 Condur SC CLASS (D) Contite PUE 200/201 Contite PUE400/401 CLASS (S) Contite PUE500/501 Contite PUE 700/701 Contite Slab Lift

PRINCIPLE	METHOD	EN 1504 PART	PRODUCTS
5 Increase in physical resistance (PR)	4.6 Filling cracks, voids or interstices	6	Condur EA1 Condur 41 Condur EF CLASS (F) Contite PUE 300/301 Condur SC CLASS (D) Contite PUE 200/201 Contite PUE400/401 CLASS (S) Contite PUE500/501 Contite PUE 700/701 Contite Slab Lift
	4.7 Pre-compression (post-tensioning)		
	5.1 Overlays or coatings	2	Floorgard HP Floorgard EB Floorgard SLT Floorgard Moisture Barrier Floorgard N Floorgard EBN Floorgard HPN Floorgard SLTN
	5.2 Impregnation	2	Contite Contite HHH Contop S
	5.3 Adding mortar or concrete	2	Conpatch 600 MCI Conpatch 600 Conpatch 600 HS Condur EA1 Condur EF Condur 41 Condur EA2 Condur EA2 (HP) Condur EM Condur EGLP2 Condur EG Condur EGhes Condur UEG CongROUT 4000 CongROUT RES

PRINCIPLE	METHOD	EN 1504 PART	PRODUCTS
6 Resistance to chemicals (RC)	6.1 Overlays or coatings	6	Floorgard HP Floorgard EB Floorgard SLT Floorgard Moisture Barrier Floorgard N Floorgard EBN Floorgard HPN Floorgard SLTN
	6.2 Impregnation	2	Contite Contite HHH Contop S
	6.3 Adding mortar or concrete	3	Condur EM Condur EGLP2 Condur EG Condur EGHEs Floorgard EB Floorgard EBN Condur UEG
PRINCIPLES RELATED TO REINFORCEMENT CORROSION			
7 Preserving or restoring passivity (RP)	7.1 Increasing cover to reinforcement with additional concrete or mortar	3	Conpatch 600 Conpatch 600 TP Conpatch 600 MCI Conpatch 600 HS Conpatch GC Condur EF Condur 41 Congrout RES Conpatch Marine Conpatch MC
	7.2 Replacing contaminated or carbonatated concrete	3	Conpatch 600 Conpatch 600 TP Conpatch 600 MCI Conpatch 600 HS Conpatch GC Condur EF Condur 41 Congrout RES Conpatch Marine Conpatch MC

PRINCIPLE

METHOD

EN 1504 PART

PRODUCTS

7.3 Electrochemical realkalisation
of carbonatated concrete

7.4 Electrochemical realkalisation
of carbonatated concrete by diffusion

7.5 Electrochemical
chloride extraction

8.1 Hydrophobic
impregnation

2

Contite 40
Contite Watershield
Contite HHH

8.2 Impregnation

2

Contite
Contite HHH
Contop S

8.3 Overlays or coatings

2

Elastoclad
Elastoclad PU
Elastoclad PU (N)
Elastodeck S
Congard Acrylic
Floorgard Moisture Barrier

8

Increasing
resistivity (IR)

9

Cathodic
control (CC)

9.1 Limiting oxygen content
(at the cathode)
by saturation or surface coating

Cormix CI
Cormix CI (T)
Conpatch NCI

10

Cathodic
protection (CP)

10.1 Applying
electrical potential

PRINCIPLE

METHOD

EN 1504 PART

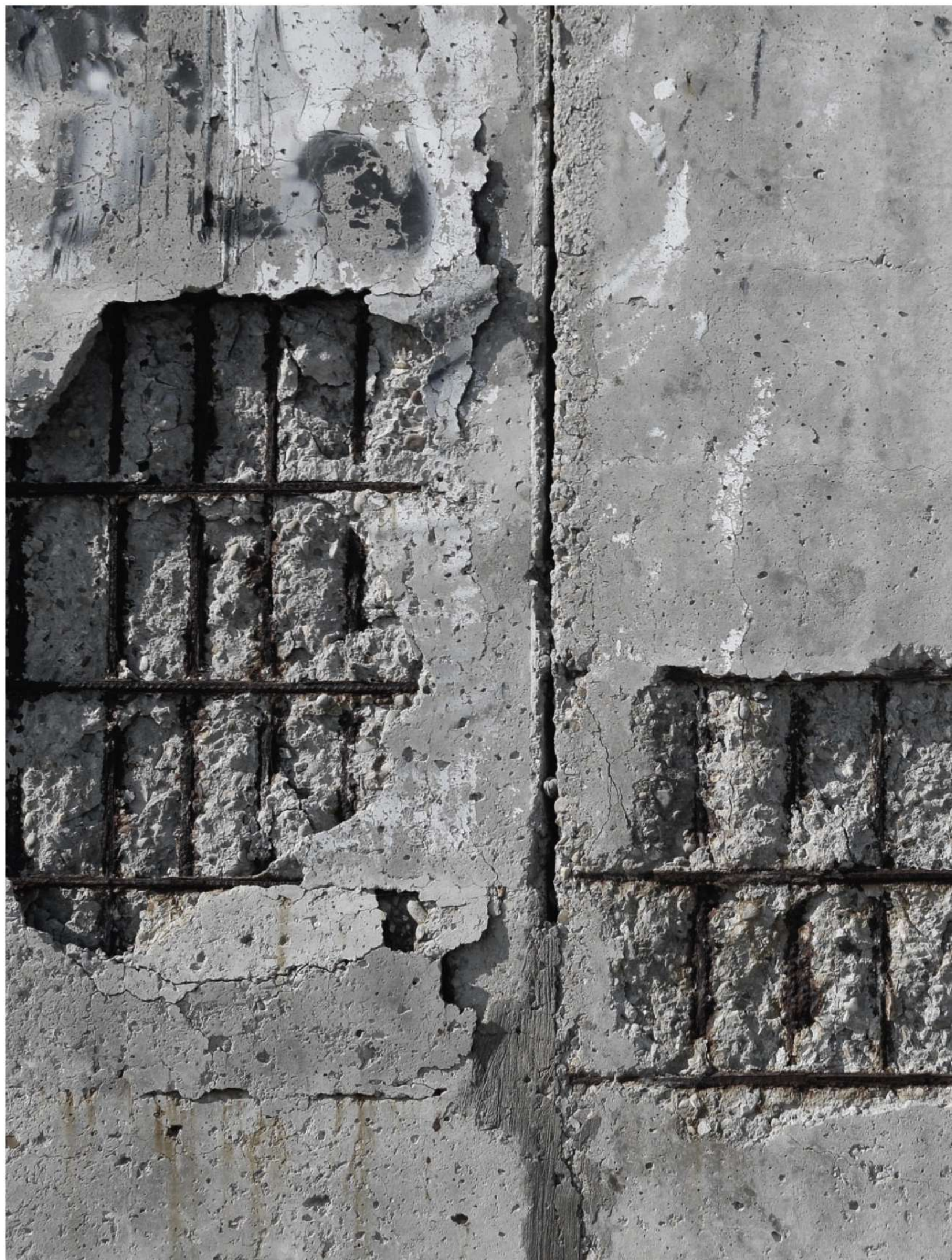
PRODUCTS

11

Control of the anodic areas (CA)

11.1 Active coating of steel reinforcement	7	Congard ST Congard Zinc
11.2 Painting reinforcement with barrier coatings	7	Congard ST Congard Zinc
11.3 Applying corrosion inhibitors on concrete		Cormix CI Cormix CI(T) Conpatch NCI







CRACK REPAIR

Cracks affect the sustainability and stability of structures. They may allow for rapid deterioration of a structure and ultimately failures. There are multiple reasons for cracking of structures including but not limited to overloading, attack to cement paste and reinforcement, impacts, and poor concreting practice.

Crack repair can be divided into various types; waterproofing, surface sealing, flexible and structural bonding.

The following pages offer some guidelines to successful sustainable crack repair

TYPES OF CRACKS

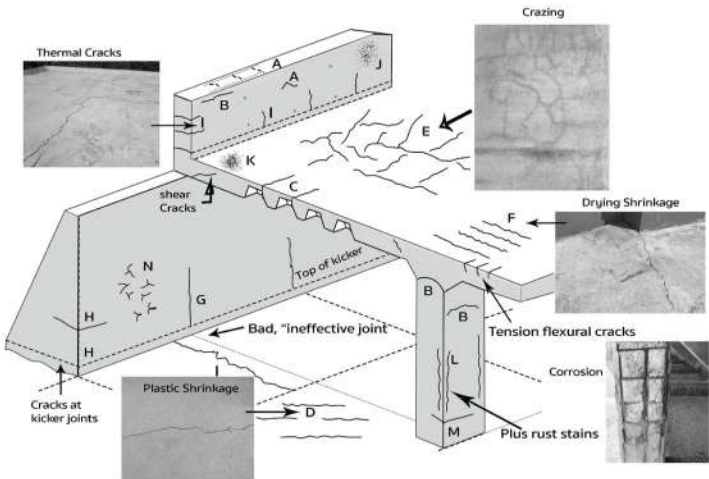
Remedial work cannot be carried out without understanding the cause of the cracking Sustainable concrete repairs require an intimate understanding of the causes of damage.

Cracks can be broadly classified as below;

- Surface hairline cracks: less than .1mm such cracks maybe treated with a surface seal such as Contite
- Settlement cracks: These are created by uneven subsidence
- Bending cracks: These appear at right angles to the reinforcement and are created by bending moments
- Shear Cracks: form from bending cracks
- Shrinkage cracks: related to too fast drying of the concrete
- Separation cracks: created by low tensile strength of concrete

CRACK TYPES FOR NON-STRUCTURAL

Type of Cracking	Designation	Time of Occurrence
Plastic settlement	A,B,C	Ten minutes to three hours
Plastic shrinkage	D,E,F	Thirty minutes to six hours
Early thermal contraction	G,H	One day to two to three weeks
Long - term drying shrinkage	I	Several weeks or months
Crazing	J,K	One to seven days- somtimes much later
Corrosion of reinforcement	L,M	Several years,but my be sooner
Alkall - aggregate reaction	N	More than five years



It is important when selecting a crack injection material to not only determine the cause of the cracking but also to understand if there are ongoing changes in the cracks geometry widths and lengths. Short term changes may be due to traffic loads day and night temperature changes or be irreversible due to a contraction due to shrinkage.

Cracks need to be assessed to determine are contaminants present that may inhibit good adhesion between the injection material and crack sides

CAUSES OF CRACKS

Cracks may be categorized generally as follows:

Those relating to the concrete itself.

- Shrinkage
- Heat or hydration stresses during curing
- Creep

Expansion in the cement paste or rebar those related to stresses:

- Chloride and salt attack to rebar & cement paste
- Over loading
- Impact
- Subsidence
- Foundation movement
- Temperature changes
- Restricted deformation



MOIST CONDITIONS AND PRODUCT SELECTION

It is important to distinguish between moist conditions when undertaking crack repair, 4 categories can be recognized.

DRY

The crack is dry no evidence of water movement.



Road / Beam

Damp

Crack colour changed by water absorption. Visibly damp



Water tank / Diaphragm wall

WET

Water droplets on the cracks surface or water Water trickling



FLOWING

Water is flowing continuously through the crack



Different conditions will impact the selection of product or products



OBJECTIVES OF CRACK SEALING

Crack sealing is undertaken to prevent the ingress of water and detrimental substances into the concrete and to reinstate the structural integrity of the components. Broadly we can categorize the objectives as follows:

- Filling of cracks against corrosive materials
- Sealing preventing leakage
- Filling of crack with re-swellable seal
- Flexible sealing and bonding allowing crack movement
- Structural sealing and bonding establishing a bond between crack that transfers forces

PRODUCTS

The selection of the injection material is determined by the objectives and conditions. The injection products should have certain properties:

- Right viscosity for the crack
- Long enough pot life to work in a wide temperature range
- Good adhesion to concrete
- Non corrosive to concrete or reinforcement
- Compatibility with materials it is in contact with

Cormix products are solvent free with low viscosity the products are formulated to be able to penetrate cracks greater than .1mm.

Very high adhesive strengths mean they reinstate durability and the load bearing capability of the element.

STRUCTURAL INJECTION PRODUCTS TYPE F

TECHNICAL PARAMETERS	CONTITE PUE 300/301	CONDUR SC	CONDUR SCC
Mixing Ratio	1 : 1.15 by Weight	4 : 1 by Weight	4.25 : 1 by Weight
	1.02 : 1 by Volume	3 : 1 by Volume	3.32 : 1 by Volume
Viscosity of Mixture (25°C)	200 -300 Cps	200 -300 Cps	≤ 100 Cps
Pot Life (25°C)	40 - 60 min	50 - 70 min	50 - 70 min
Application temperature	>5°C	>8°C	>5°C
Properties and used	• Low viscosity • 100% Solid - Solvent Free • Suitable for structural crack sealing in concrete structures such as basements, tunnels, precast concrete segments	• Low viscosity • 100% Solid - Solvent Free • Suitable for structural crack sealing in concrete structures such as basements, tunnels, precast concrete segments	• Very low viscosity • 100% Solid - Solvent Free • Suitable for structural crack sealing in concrete structures such as basements, tunnels, precast concrete segments
Performance characteristics as per EN1504 - Part 5	U(D1)W(1)(1)(5/30)(1)	U(F1)W(1)(1)(8/30)(0)	U(F1)W(1)(1)(5/30)(0)

FLEXIBLE CRACK FILLING RESINS TYPE D

TECHNICAL PARAMETERS	CONTITE PUE 200/201	CONTITE PUE 300/301	CONTITE PUE 400/E401
Mixing Ratio	5 : 3 by Weight	1 : 1.15 by Weight	1:1 by weight
	2 : 1 by Volume	1.02 : 1 by Volume	1.1 : 1 by volume
Viscosity of Mixture (25°C)	100 - 200 Cps	200 -300 Cps	≤ 100 Cps
Pot Life (25°C)	60 - 70 min	40 - 60 min	15 - 20 min
Application temperature	>5°C	>8°C	>5°C
Properties and used	• Low viscosity • 100% Solid - Solvent free • Suitable for elastic sealing of cracks in concrete structures such as basements, tunnels etc. • The sealing of cracks and joints and leaks in otherstructures.	• Low viscosity • 100% Solid - Solvent free • Suitable for structural crack sealing in concrete structures such as basements, tunnels, precast concrete segments etc	• Low viscosity • 100% Solid - Solvent free. • Suitable for injection to dry & wet cracks. • Stopping water seepage. • Sealing leaking cracks & voids. • Injection in leaking diaphragm walls. • Sealing leaks in tunnels, basements, subways, pipe lines, manholes, dams, reservoirs, pools, water tanks etc.
Performance characteristics as per EN1504 - Part 5	U(D2)W(1)(1)(5/30)(1)	U(D1)W(1)(1)(5/30)(1)	U(D2)W(1)(1/2/3)(5/30)(1)

WATER STOPPING PU FOAMS AND GELS

TECHNICAL PARAMETERS	CONTITE PU 100/101	CONTITE PU 100(1K)	CONTITE G600	CONTITE PUE500/501
Type			1K Polyurethane Injection Grout	2K Polyurethane Injection Grout
Mixing Ratio	10 : 1 by Weight	N.A (1K Product)	N.A (1K Product)	Part A : Part B = 1 : 1 by Volume
Viscosity of Mixture (25°C)	50 - 150 Cps	250 - 450 Cps	350 - 650 Cps	100 - 200 Cps
Pot Life (25°C)	4 - 8 hours when protected from Moisture	N.A (1K Product)	N.A (1K Product)	5 Minutes
Reaction Time with Water			1 : 1 by weight 15 - 10 Seconds (Foam) 1 : 5 by weight 20 - 25 Seconds (Gel)	20 - 30 Seconds
Application temperature	>5°C	>5°C	>5°C	>5°C
Properties and uses	Very Low viscosity	Low viscosity	Low viscosity	Low viscosity
	100% Solid - Solvent Free	100% Solid - Solvent Free	100% Solid - Solvent free, Hydrophillic Flexible Elastomeric Gel.	100% Solid - Solvent free Rigid PU Foam.
	Stopping water seepage.	Stopping water seepage.	Shutting off Heavy Water Leakage Pemanently.	Compressive Strength with Fine sand > 40 Mpa (7)
	Sealing leaking cracks & voids.	Sealing leaking cracks & voids.	Shutting off water seepage, forming a positive side waterproof membrane with below grade structures injected from the negative side, for reinjectable hoses & soil stabilization	Shutting off Heavy Water Leakage Pemanently
	Injection in leaking diaphragm walls.	Injection in leaking diaphragm walls.	Prevention of water leakage in sewerage and drain pipes, ground stabilization	Soil and rock consolidation with increase in Load Bearing capacity by filling of large voids, cracks and crevices in Soil.
	Sealing leaks in tunnels, basements, subways, pipe lines, manholes, dams, reservoirs, pools, water tanks etc.	Sealing leaks in tunnels, basements, subways, pipe lines, manholes, dams, reservoirs, pools, water tanks etc.	Prevention of water leaks through expansion or construction joints, etc.	Pre injection for waterproofing and con-solidation in front of TBM and drill and blast
Performance characteristics as per EN1504-Part 5	U(D2)W(1)(3/4)(5/30)(0)	U(D2)W(1)(3/4)(5/30)(0)		

EQUIPMENT

SINGLE COMPONENT PUMP

When applying injection resins using single component pumps both components are mixed together first and put into the pump hopper, some products such as foams may not be suitable for single component pumps

Brand: GRACO

Model: Ultra Max II 595 PC PRO

Pressure range: 0-3300 PSI

We recommend for injection around 1-2 bar



2 COMPONENT PUMP

When using 2 component pumps both components are introduced to a mixing head separately mixed there and injected. This type of pump is usually used with fast reacting products with large volumes of materials

Brand: Desoi

Model: DESOI FlowControl II – A

Pressure range: 5-120 bar

We recommend for injection around 10-12 bar



INJECTION PACKERS

These may be surface applied or be mechanical or hammer in packers.

Injection packers are the connection between the structural element and the pump

Surface packers: Surface packers are glued directly on to the crack and the surface between packers sealed with epoxy adhesive Condur EA1 No drilling is required



Drilled hole packers:

Drilled hole packers may be mechanical packers that are anchored into the drilled hole by screwing whilst hammer-in packers are installed by hammer



Mechanical Packer



Hammer-In Packer

APPLICATION

Good preparation will help to ensure successful injection that includes selection of the correct injection material

Surface preparation:

Holes are normally drilled on either side of the crack alternatively at 45 degrees angle to the crack.

The distance between packers is determined by the crack width, element depth, pot lifes and viscosities.

The drill holes are cleaned out by brush, vacuum or compressed air Mechanical packers are placed into the drill hole and tightened in the element

If it is not possible to drill holes surface packers may be installed on the surface by gluing and are encapsulated with surface seal epoxy adhesive.

Condur EA1 is used to seal the cracks surfaces and install surface packers.

The surface seal is there to ensure good filling of the cracks and good structural strength achieved.

The packers are spaced at a distance equal to the elements thickness. To prevent blockage of the crack where injection material will be injected a nail is inserted into the crack to which the packer is fitted this is removed prior to injection.

Condur EA1 is applied to a minimum of 10cm wide and 3 mm thick along the crack. At the highest point of the crack an air vent should be left. After fixing the packers they are checked for connection by compressed air

Injection:

The cracks are injected from bottom to top, once material emerges from the next adjacent packer injection is moved, a secondary injection may be required to completely fill the cracks. Injection pressures vary maximum pressure is normally calculated as below:

$$\text{Max. Pressure} = \frac{\text{Concrete Strength (Cube, MPa)} \times 10 \text{ bar}}{3}$$

Surface sealing of cracks:

Horizontal surface cracks can be sealed by gravity feed without pressure using products with good wetting capabilities and viscosity.



Application of Cormix Injection Contite G600:



Drilling hole>> Removing dust and dirt



Tightening and fixing packers



Injection>> Removing packers>> Closing packer holes



CURTAIN INJECTION GROUTING

Cormix maintains a series of versatile systems for the effective surface sealing or water cut off in inaccessible below grade situations.

The injection material either in gel form or rigid hydrophobic foams form a curtain to protect the structure from water ingress.

Sealing with Contite G600 Injection gels. Structures can be badly damaged as a result of water pressure and rising water tables. Water can penetrate through failed waterproofing systems finding its way through cavities, cracks porous substrate or joints. Exposing the exterior of a leaking area is often problematic with poor access or non at all. Interior sealing of the structure only temporarily solves the problem.

Traditional methods of positive side sealing from the negative side have used acrylic gels Cormix, however, uses more advanced technology namely Polyurethane hydrophillic gels to form permanent waterproof flexible seals.

Areas of use include:

- Foundation pits
- Basements
- Tunnels
- Underground car parks
- Retaining walls
- Floor slabs
- Expansion joints using oakum technique
- Joints between old and new buildings
- Sewer connections

Gel injection is used in specific problem areas such as:

- Positive side waterproofing is not possible as no access can be given
- The surface requiring sealing is inaccessible
- A low interference method is needed
- Costs of removal of soils to expose the areas are very high

Prior to starting injection an analysis of the structure and surrounding area is required.

The preparation should include planning considering the following points:

- Clear identification of areas to be sealed
- Checking of drill hole spacing
- Consideration to changes in water movement after grouting
- Coring of structure if structures make up is not known

Soil investigations around the areas to be grouted:

- Soil conditions
- Pore volumes
- Water content
- Ph levels etc

CORMIX PRODUCTS

Cormix has various products available to stop water ingress and movement below grade which can be used singularly or in conjunction with each other

Contite Soil Stab

low strength temporary below grade water shut off gel

Contite PUE 500/501

Permanent high strength PU foam

Contite PUE 700/701

Permanent very rapid high strength PU foam

Contite G600

A hydrophilic versatile polyurethane permanent sealing gel membrane



CONTITE G600 POLYURETHANE INJECTION GEL FOR CURTAIN GROUTING

Contite G600 is a highly versatile gel that can be premixed with water from 1:1 to 1:5 to form a semi rigid rubber like plug or flexible permanent gel membrane

TECHNICAL PARAMETERS	CONTITE G600
Type	1K Polyurethane Injection Grout
Mixing Ratio	N.A (1K Product)
Viscosity of Mixture (25°C)	350 - 650 Cps
Pot Life (25°C)	N.A (1K Product)
Reaction Time with Water	1 : 1 by weight 15 - 10 Seconds (Foam) 1 : 5 by weight 20 - 25 Seconds (Gel)
Application temperature	> 5°C
Properties	• Low viscosity • 100% Solid - Solvent free, Hydrophillic Flexible Elastomeric Gel. • Shutting off Heavy Water Leakage Pemanently. • Shutting off water seepage, forming a positive side waterproof membrane with below grade structures injected from the negative side, for reinjectable hoses & soil stabilization • Prevention of water leakage in sewerage and drain pipes, ground stabilization • Prevention of water leaks through expansion or construction joints, etc.

PUMP

Injection Pumps

Contite G600 can be pumped by a single component pump or a 2C pump where G600 is introduced through one nozzle and water the other



Brand: GRACO

Model: Ultra Max II 595 PC PRO

Pressure range: 5-120 bar



Brand: Desoi

Model: DESOI FlowControl II – A

Pressure range: 5-120 bar

Injection Packers



Mechanical Packer



Hammer - In Packer

Various types of packer are available from Cormix depending on the substrate and depth of the structure

Positive side waterproofing from the negative side with Curtain injection

This method of waterproofing a leaking structure is often used in tunnels and deep basements where there is no access to the positive side.

There may have been no positive side waterproofing or it has failed, joints are leaking or there is porous concrete or cracks apparent. The gel is injected under pressure it will flow with moving water finally reacting to seal cracks fissures joints areas of water ingress and the complete surface of the structure forming a permanent gel membrane.

The initial investigation will have determined quantities of material to use and injection port spacing. Drill holes are normally spaced at 30-50cm intervals in rows the packers will have button head fittings. Injection normally starts at the bottom drill holes and continues until gel emerges from an adjacent drill hole.

The membrane formed on the positive side of the structure has excellent adhesion properties it will seal cracks, porous concrete and joints. Consumption rates vary depending on the density of soils voids and water flow

EXPANSION JOINTS

Expansion joints can be sealed with the so called oakum technique details are available from Cormix. Alternatively gel may be injected at an angle to intersect the expansion joint behind any preexisting waterstop, material will fill the expansion joint and adjacent soil.

After injection is completed remove packers and gel from the drill hole and seal the hole with Contite Seal Mortar.

Having sealed the existing water movement routes additional injection may be required to seal other areas where the water has moved to finding additional porous, cracked or honeycombed concrete. This is normal for this type of work





CORMIX
One step ahead

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